**Department of Consumer &
Corporate Affairs & Environment**

Environmental Management Division

Environmental Management Services

MONITORING OF MERCURY

IN

MANITOBA MINK AND OTTER

Environmental Standards and Studies

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MONITORING OF MERCURY
IN
MANITOBA MINK AND OTTER

FOR GENERAL DISTRIBUTION

ENVIRONMENTAL MANAGEMENT
PROVINCE OF MANITOBA

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INTRODUCTION

In 1979 the Environmental Management Division expanded the monitoring of mercury by initiating a program that uses two fish-eating mammals - mink and otter - as biological indicators of environmental mercury levels. This brochure explains the program and its benefits, and summarizes results of the first two years of the study.

REASONS FOR THE MONITORING

The status of pollutants in animals is monitored for two important reasons:

Firstly - for the sake of people, and human health. The animals serve as biological indicators of a pollutant level in the environment. They are sentinels which provide early warning of potential dangers to human health.

Secondly - for sake of the animals themselves. Many species, such as the furbearers used in the mercury monitoring, are of direct economic importance. Continued survival of wildlife populations is essential not only for our use and enjoyment, but for proper functioning of the life systems on which human survival also depends.

MINK AND OTTER

Mink and otter are two members of the weasel family that have adapted to life closely connected with water. Otter is the larger of the two, about 40 inches (1 m) in length. An excellent swimmer, it feeds primarily on fish, and is more than a match for the fastest of them. An otter's home range may include up to 25 miles (45 km) of a stream.

Mink is usually a little less than half the size of an otter, has a home range of up to 3 square miles, and ventures more often onto dry land where it hunts mice and other small animals. However, both mink and otter find their food mainly in water - fish, crayfish, shellfish, aquatic crustaceans.

Economically, mink and otter are valued for their fur; they are trapped during the winter when it is in prime condition. The 1978-79 Manitoba harvest was 3464 otter and 20284 mink pelts.

MERCURY IN THE ENVIRONMENT

Mercury occurs naturally in relatively minor concentrations in the air, soils, rock, water, and plants and animals. However, with the advent of the industrial era increasing amounts of mercury have been added to the environment as a result of man's various activities. Wastes from chlor-alkali plants, kraft paper mills, mercurial seed dressings, various fungicides, even tiny amounts of mercury from use in dental laboratories for fillings - all find their way into rivers and lakes, often drastically and dangerously increasing the natural levels. Living organisms accumulate mercury from the water and in the food chain, which eventually leads to contamination of human food.

TRANSFER OF MERCURY IN THE FOOD CHAIN

In simple terms, a food chain is a community of organisms, usually including both plants and animals, in which those said to be on higher level feed on one or more of the lower level groups. Animals on higher levels of food chain thus receive relatively more mercury than the ones they feed on. (Figure 1). Because mercury can accumulate in the body faster than it can be eliminated, it can in time reach toxic concentrations.

EXTENT OF THE PROBLEM IN MANITOBA

No poisoning by mercury from environmental sources was ever recorded in Manitoba. However, in several cases levels of mercury in fish necessitated temporary banning of commercial fishing on some northern lakes, and provincial surveys indicated contamination of wildlife in some areas of southern Manitoba.

Increased levels of mercury were found by federal and provincial surveys in recent years in fish and wildlife from several areas and water bodies of the province. In some (such as the Burntwood River) the sources of mercury are not yet clearly defined; in others they can be identified with some degree of certainty; for example, contamination of Winnipeg River was essentially caused by the operations of paper mills on its upper reaches in Ontario. The Manitoba Environmental Management Division is keeping surveillance of the situation with increased monitoring efforts - of which this study is a part.

MERCURY TOXICITY

Although trace amounts of mercury are contained naturally in tissues of man and other mammals, mercury is not needed for any biological functions of the body, and even relatively small amounts of mercury, whether ingested or inhaled, are highly poisonous. The effects of acute mercury poisoning range from nausea, headache, and stomach pains to decreased vision, hallucinations, delirium and death. Effects of chronic poisoning (occurring from intake of smaller amounts over long periods of time) are similar, although less severe.

The dangers of poisoning from mercury released into the environment were dramatically demonstrated during the fifties in Japan where at Minamata 43 people died and further 68 became disabled from consumption of fishes that were heavily contaminated by mercury from a nearby industrial source.

Ingested mercury is carried to various organs of the body. The organs that accumulate most are liver and kidneys. Organic forms of mercury damage the nervous system, and accumulate primarily in the brain.

STUDY METHODS

The program involves:

a) collection of animals;

b) dissecting, aging, collection of biological data;

c) chemical analyses;

d) comparisons and evaluation.

None of the animals were killed for the sole purpose of this project. Instead, skinned carcasses, which are normally discarded, were bought from licensed trappers in the study areas.

In the laboratory biological information was recorded and parts of kidney, liver and brain were dissected out. These organs were then preserved freeze-dried until the chemical analysis.

Chemical analyses for mercury were done by the W.M. Ward Technical Services Laboratory, with the help of sophisticated, partially automatic apparatus. Results of these analyses showed tissue concentrations of mercury, in µg/g (or ppm - parts per million).

Finally, the analytical results were compared among the different study areas, and with data from research conducted elsewhere.

For the pilot project samples were collected from the areas shown in Figure 2:drainages of five rivers (see map).

Winnipeg River samples came from traplines on the river itself, from the Ontario border west to Pointe du Bois; Burntwood River samples from the Nelson House Registered Trapline Area on the Burntwood River. Wekusko samples are from the vicinity of Wekusko Lake - in the very clean Grass River watershed. Whiteshell samples are from the Whiteshell River drainage in the same system as Winnipeg River. Duck Mountain samples include animals trapped in Duck and Porcupine Mountains. The majority of this area is contained within the Dauphin River watershed.

RESULTS TO DATE

Average concentrations of mercury in tissues of animals from different areas were not the same, but did reflect the relative amounts of mercury in a given watershed. Winnipeg River and Burntwood River animals had higher concentrations than the rest. Fish from these rivers were known to have elevated concentrations of mercury as well. In general, the mink and otter accumulated about ten times as much mercury as fish from the same watershed.

SIGNIFICANCE OF THE FINDINGS

The chart in Figure 3 compares Manitoba data with some data from other research sources. Winnipeg and Burntwood Rivers are under surveillance of the provincial authorities to ensure that people are not exposed to such amounts of contaminated fish that would cause health problems. Monitoring of both fish and mammal populations is continuing. Commercial fish catch is also routinely analyzed by federal personnel.

As for the furbearer population, at the present levels there appears to be no danger to the mink and otter in any of the study areas. However, owing to the high concentration of mercury in their organs these animals would be the first organisms in a given watershed to reflect any extraneous addition of mercury to the river system. There lies the main value of this monitoring program.

BENEFITS OF THE MONITORING

All analytical methods have certain detection capability limits - that is, lowest concentrations that they are capable to register. With higher concentrations, the analyses are easier, more sensitive and precise. It is therefore advantageous to use the mammals, top predators in their food chain, as the indicator species, because their tissue mercury contents are the highest - e.g., ten times higher than in fish. With the increased sensitivity, areas of potential danger can be identified early, and results may also help to pinpoint the pollutant source.

Incidental to the main objective, other useful data, especially on life history, are being obtained. Information on the age/sex structure of furbearer populations is useful to the resource managers. Stomach contents of mink from the 1979/80 collection were analysed by a University of Manitoba graduate student who studied mink food habits. The preserved skeletal material is being used to find additional aging criteria, and will be also available for other zoological studies.

PRESENT STATUS OF THE PROGRAM

The pilot study was a success in that it showed that monitoring

of mercury through fish-eating mammals is a viable, sensitive, and inexpensive method. The program was developed by the Environmental Management staff in Manitoba, and although it is similar to some published studies from Georgia, U.S.A., it may be a one-of-its-kind program currently used by environmental authorities.

The program is being gradually expanded to cover additional areas of the Province, and it is hoped that it will continue to supply data useful in our efforts to maintain a healthy environment for the people of Manitoba.

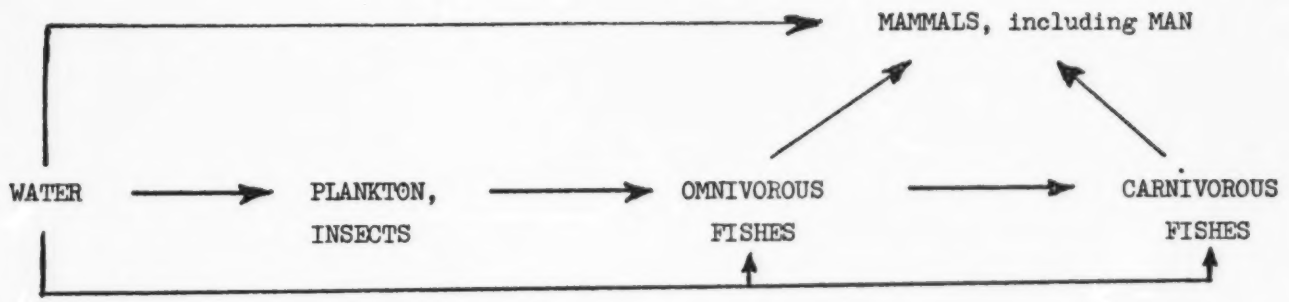

Figure 1. Simple schematic of mercury transfer in aquatic food chain from water to mammals

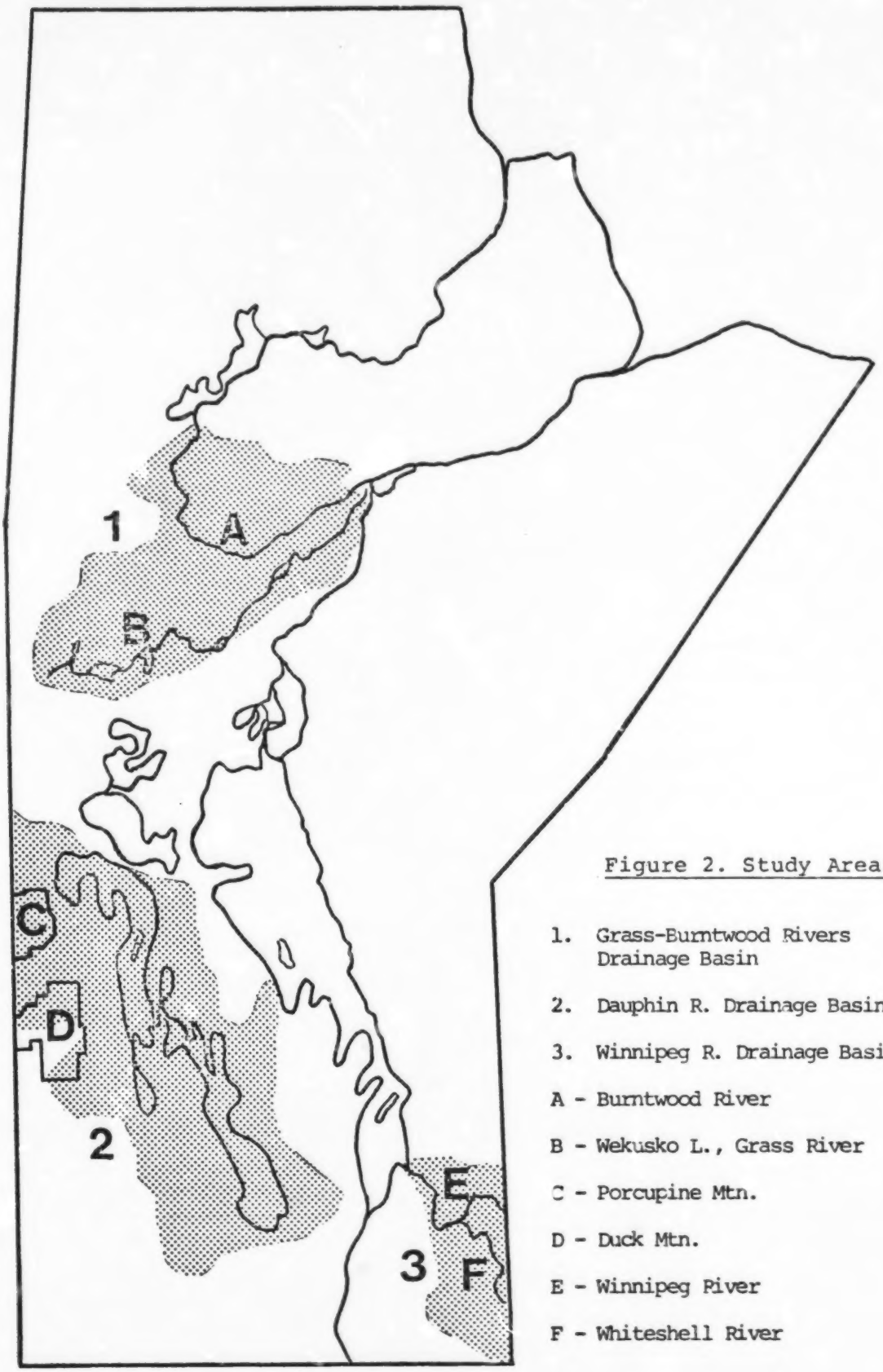

Figure 2. Study Areas

1. Grass-Burntwood Rivers Drainage Basin
2. Dauphin R. Drainage Basin
3. Winnipeg R. Drainage Basin

A - Burntwood River

B - Wekusko L., Grass River

C - Porcupine Mtn.

D - Duck Mtn.

E - Winnipeg River

F - Whiteshell River

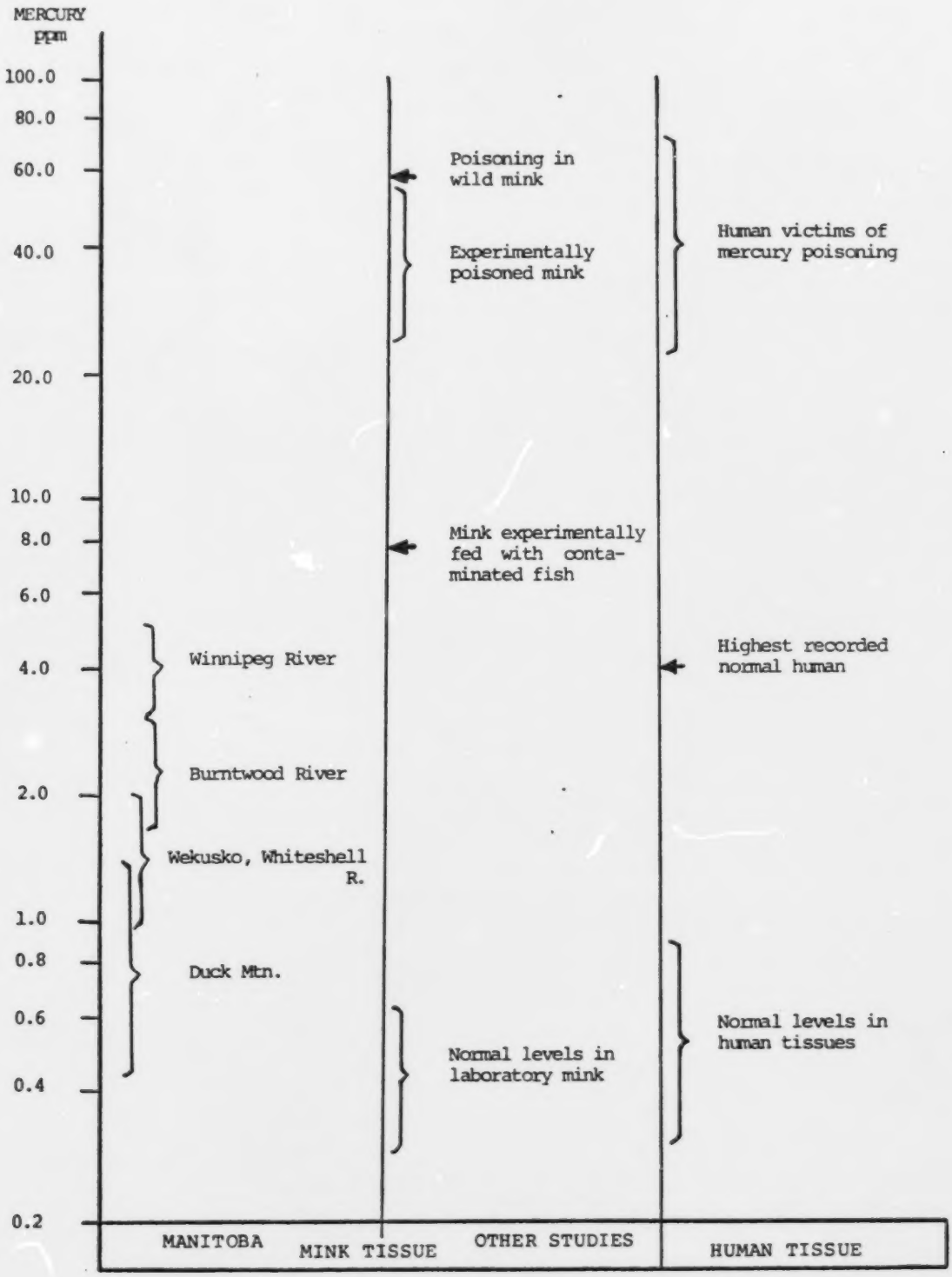

Figure 3. Average levels of mercury in liver tissue